Please amend claims 9, 11, 13, 15, 17, 25, 27, and 28 to read as follows:

9. (Twice amended) An analog, oligomer-based method for determining a mathematical result of carrying out an operation of vector or matrix algebra on input data,

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wherein single-stranded oligomers E_i and $\underline{E}_i$ are a subset of all single-stranded oligomers and are each in 1:1 correspondence with the basis vectors $\boldsymbol{e}_i$, $i = 1, 2, \ldots, m$ in an abstract m-dimensional vector space;

wherein a set of the oligomers E_i and $\underline{E}_i$ represents an m-component vector $\boldsymbol{V} = \Sigma_i V_i \boldsymbol{e}_i$, wherein the E_i and $\underline{E}_i$ oligomers have complementary nucleotide sequences, with the E_i oligomers representing the i-th component of $\boldsymbol{V}$ for which the amplitude V_i is positive, and the $\underline{E}_i$ oligomers representing the i-th component of $\boldsymbol{V}$ for which V_i is negative; and

wherein the concentration of each of the oligomers E_i or $\underline{E}_i$ is proportional to the absolute value of the amplitude V_i of the i-th component of $\boldsymbol{V}$,

the method comprising the steps of

(1) obtaining a composition comprising at least one set of single-stranded oligomers E_i and $\underline{E}_i$ representing the components of a vector, wherein the concentrations of the oligomers E_i or $\underline{E}_i$ in the composition are proportional to the absolute values of the amplitudes of the components they represent, which

composition represents input data; and

2) subjecting said composition to at least one physical or chemical treatment having an effect on said oligomers in said composition that is an analog representation of an operation of vector or matrix algebra, and

(3) detecting the effect of said treatment on said oligomers in said composition to determine the analog result of carrying out said operation of vector or matrix algebra on said input data;

wherein said analog result of carrying out said operation of vector or matrix algebra on said input data is quantitatively dependent on the concentrations of said at least one set of single-stranded oligomers E_i and E_i in said composition.

11. (Twice amended) The method of claim 10, wherein said at least one physical or chemical treatment in step (2) is selected from the group consisting of (a) changing the relative concentrations of the oligomers in said composition, (b) allowing complementary oligomers in said composition to hybridize to each other, (c) determining the concentration of double-stranded oligomers in the composition, (d) separating double-stranded oligomers from non-double-stranded oligomers in the composition, (e) measuring the rate of hybridization of

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I2

complementary oligomers in the composition, (f) ligating oligomers together, (g) adding oligomer subunits to an end of an oligomer in an enzyme-catalyzed reaction, (h) using an oligomer as a template in synthesizing a complementary oligomer sequence in a polymerase-catalyzed reaction, (i) phosphorylating or de-phosphorylating a 5′ terminus of an oligomer in an enzyme-catalyzed reaction, and (k) cleaving an oligomer with a restriction enzyme.

G3 cnd

G4

Sub C'

13. (Amended) The method of claim 11 wherein said operation of matrix algebra is addition of vectors, and

said method comprises obtaining, for each vector to be added, a set of single-stranded oligomers E_i and $\underline{E}_i$ representing the components of the vector, wherein the concentrations of the oligomers E_i and $\underline{E}_i$ are proportional to the absolute values of the amplitudes of the components they represent;

mixing together, for each vector to be added, an amount of the set of oligomers representing said vector that is normalized to be proportional to the sum of the absolute values of the amplitudes of the components of said vector;

allowing complementary oligomers in the resulting mixture to hybridize under conditions that allow only complementary E_i and $\underline{E}_i$ strands to hybridize to form stable double-stranded DNA

complexes; and

separating the fully hybridized, double-stranded oligomers from the resulting mixture of oligomers, thereby obtaining a set of non-double-stranded oligomers that represents the sum of the added vectors.

G4 cncl

15. (Amended) The method of claim 11 wherein said operation of matrix algebra is obtaining the outer product matrix of two vectors V_i for i = 1, 2, ..., m, and W_j for j = 1, 2, ..., n, and

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said method comprises obtaining a set of dimeric, single-stranded oligomers, each of which comprises (i) a first single-stranded oligomer sequence selected from the group consisting of E_i or $\underline{E}_i$ for each i-th component of **V** for i = 1, 2, ... m, [and] which oligomer is joined at its 3′ end to the 5′ end of (ii) a second single-stranded oligomer sequence selected from the group consisting of E_j or $\underline{E}_j$ for each j-th component of **W** for all j = 1 to j = n,

wherein said resulting set of single-stranded, dimeric oligomers is an analog representation of the matrix formed as the outer product of said two vectors.

17. (Twice amended) A method for obtaining a data set V_i^b from an oligomer-based, content-addressable memory following input of a data set U_i^b that represents a portion of V_i^b,

6b

wherein data elements in the form of m-component vectors $\boldsymbol{V} = \Sigma_i V_i \mathbf{e}_i$ are represented in the memory by a set of the oligomers E_i and $\underline{E}_i$ that are a subset of all single-stranded oligomers and are in 1:1 correspondence with the basis vectors $\mathbf{e}_i$ for $i = 1, 2, \ldots m$ in an abstract m-dimensional vector space;

wherein oligomers E_i and $\underline{E}_i$ have complementary nucleotide sequences, with E_i oligomers representing the i-th component of $\boldsymbol{V}$ for which the amplitude V_i is positive, and $\underline{E}_i$ representing the i-th component of $\boldsymbol{V}$ for which V_i is negative; and

wherein the concentration of each of oligomers E_i and $\underline{E}_i$ is proportional to the absolute value of the amplitude V_i of the i-th component of $\boldsymbol{V}$;

the method comprising:

(a) preparing a content-addressable memory representing memory matrix T_{ij} in which are stored data sets corresponding to vectors V_i^a for a = 1 to a = n, where i = 1, 2, ..., m, wherein T_{ij} is the sum of all of the outer products $V_i^a V_i^a$ for $i \neq j$;

comprising obtaining for each vector $\mathbf{V}^a$ a set of single-stranded oligomers, each of which comprises a first single-stranded oligomer sequence selected from the group consisting of

E_i or $\underline{E}_i$ for each i-th component of $\mathbf{V}^a$ for i = 1 to i = m, and further comprises a second single-stranded oligomer sequence selected from the group consisting of E_j or $\underline{E}_j$ for each j-th component of $\mathbf{V}^a$ for j = 1 to j = m, except for i = j; and then pooling said sets of dimeric oligomers obtained for each vector $\mathbf{V}^a$ for a = 1 to a = n thereby forming a set of oligomers representing a content-addressable memory;

(b) combining said pool of dimeric oligomers with a set of oligomers representing partial data set U_i^b under conditions wherein oligomer sequences E_i^b and $\underline{E}_i^b$ of data set U_i^b hybridize specifically to complementary sequences E_j and $\underline{E}_j$ present in said memory pool oligomers; and

obtaining an isolated set of monomeric oligomer strands X_i comprising the oligomer sequences E_i and $\underline{E}_i$ of said memory pool oligomers that hybridized specifically to said U_i^b oligomers, wherein said X_i oligomers do not further comprise said E_j and $\underline{E}_j$ sequences of said memory pool oligomers that are complementary to said U_i^b oligomers;

(c) combining said set of X_i oligomers with a set of single-stranded saturating oligomers comprising a set of E_i and $\underline{E}_i$ oligomers representing the complete set of basis vectors $\boldsymbol{e}_i$ for i = 1 to m, wherein the E_i and $\underline{E}_i$ oligomers are sub-stoichiometric relative to said set of X_i oligomers, in that the

number of oligomers in the set of X_i oligomers is greater than the number of saturating oligomers, so that complementary sequences hybridize to each other, denaturing the resulting duplex molecules, and isolating the subset of X_i oligomer that hybridized specifically to said E_i and $\underline{E}_i$ sequences, to obtain a set of saturated X_i strands, $\mathbf{S}(X_i)$;

(d) repeating steps (b) and (c) iteratively, using the set of saturated X_i strands, $\mathbf{S}(X_i)$ obtained in each previous implementation of step (c) as the set of oligomers representing partial data set U_i^b employed in the subsequent implementation of step (b), until successive iterations yield the same set of oligomer strands X_i produced by step (b) that represents data set V_i^b.

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25. (Twice amended) A content-addressable memory representing a memory matrix T_{ij} in which are stored data sets corresponding to vectors V_i^a for i = 1 to i = m, wherein T_{ij} is the sum of all of the outer products V_i^a V_i^a for $i \neq j$;

wherein data elements in the form of m-component vectors $\mathbf{V} = \Sigma_i V_i \mathbf{e}_i$ are each represented in the memory by a set of the oligomers E_i and $\underline{E}_i$ that are a subset of all single-stranded oligomers and are each in 1:1 correspondence with the basis vectors $\mathbf{e}_i$ for i = 1, 2, ...m in an abstract m-dimensional vector

space;

wherein oligomers E_i and $\underline{E}_i$ have complementary nucleotide sequences, with E_i oligomers representing the i-th component of $\boldsymbol{V}$ for which the amplitude V_i is positive, and $\underline{E}_i$ representing the i-th component of $\boldsymbol{V}$ for which V_i is negative; and

wherein the concentration of each of oligomers E_i and $\underline{E}_i$ is proportional to the magnitude of the amplitude V_i of the i-th component of $\boldsymbol{V}$; comprising:

a content-addressable memory representing memory matrix T_{ij} in which are stored data sets corresponding to vectors V_i^a for a = 1 to a = n, where i = 1, 2, ..., m,

comprising a pool of dimeric, single-stranded oligomers comprising a set of dimeric oligomers for each vector $\mathbf{V}^a$,

wherein each dimeric oligomer in the set of oligomers for each vector $\mathbf{V}^a$ comprises a first single-stranded oligomer sequence selected from the group consisting of E_i or $\underline{E}_i$ for each i-th component of $\mathbf{V}^a$ for i = 1, 2, ...m,

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which oligomer is attached at its 3′ end to the 5′ end of a second single-stranded oligomer sequence selected from the group consisting of E_j or $\underline{E}_j$ for each j-th component of $\mathbf{V}^a$ for all j = 1 to j = m, except for i = j.

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27. (Twice amended) The method of claim 11 wherein said operation of matrix algebra is determining the inner product of two vectors ***V*** and ***W***, and said method comprises:

(i) obtaining for each vector ***V*** and ***W***, sets of single-stranded oligomers E_i and $\underline{E}_i$ representing the components of the vector, wherein the concentrations of the oligomers E_i and $\underline{E}_i$ are proportional to the absolute values of the amplitudes of the components they represent; and

also obtaining a set of single-stranded oligomers E_i and $\underline{E}_i$ representing the components of vector $\underline{\boldsymbol{W}}$ that are complementary to said oligomers representing vector ***W***, wherein the relative concentrations of the oligomers representing $\underline{\boldsymbol{W}}$ are proportional to the concentrations of their complementary oligomers in ***W***,

wherein the nucleotide sequences of oligomers that represent the components of said vectors ***V***, ***W***, and $\underline{\boldsymbol{W}}$ have minimal overlap with the nucleotide sequences of the oligomers representing the other components of said vectors;

(ii) combining samples of the oligomers representing vector ***V*** with samples of the oligomers representing vectors ***W*** and $\underline{\boldsymbol{W}}$ in separate reaction mixtures and measuring the rates of hybridization of said mixtures, and obtaining a numerical value proportional to the inner product of the two vectors from said rates of hybridization.

28. (Twice Amended) The method of claim 11 wherein said operation of matrix algebra is obtaining the inner product of a matrix and a vector, and

said method comprises

(a) obtaining a set of single-stranded oligomers representing matrix **T**, wherein each matrix component T_{ij} is represented by single-stranded oligomers comprising a dimeric oligomer sequence of the form 5′-A-B-3′ selected from the group consisting of 5′-$\{E_i\}\{E_j\}$-3′, 5′-$\{E_i\}\{\underline{E}_j\}$-3′, 5′-$\{\underline{E}_i\}\{E_j\}$-3′, and 5′-$\{\underline{E}_i\}\{\underline{E}_j\}$-3′, and wherein the concentrations of said dimeric oligomers T_{ij} are proportional to the absolute values of the amplitudes of the matrix components they represent;

(b) obtaining a set of single-stranded oligomers E_i and $\underline{E}_i$ representing the components of a vector **V**, wherein the concentrations of said oligomers E_i and $\underline{E}_i$ are proportional to the absolute values of the amplitudes V_i of the vector components they represent,

wherein the nucleotide sequences of oligomers that represent <u>the</u> components of said matrix **T** and said vector **V** have minimal overlap with the nucleotide sequences of the oligomers representing the other components of said matrix and said vector;

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(c) obtaining a set S of single-stranded oligomers E_i and $\underline{E}_i$ having the sequences of the A portions of those dimeric oligomers representing matrix T_{ij} which also comprise in their B portions sequences which are either the same as or complementary to the oligomers representing said vector **V**,

wherein the set of single-stranded oligomers ***S*** is an analog representation of the inner product of said matrix **T** and said vector **V**.